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ABSTRACT

This paper reports two experiments related to elementary school children's learning of geometric concepts. The geometry experiment investigated the effects of location of practice problems within a programmed text; the polygon experiment involved two variables, number of illustrative examples presented, and number of practice problems given. Both experiments involved the same fifth-grade students; the experiments were administered consecutively in a 5-day period. Students were pretested using arithmetic reasoning, geometry, and missing words tests. They were then given one of two programmed geometry texts depending on the treatment group (all practice immediately after concept vs. practice interspersed). The geometry posttest was followed by work with programmed texts on polygons and the polygon posttest. Four treatment groups were used for polygons; these were defined by many vs. few examples and many vs. few practice problems. Results indicated that overall there was no difference attributable to massed vs. dispersed practice problems although the effectiveness of distributed problems increased with mathematics ability. Neither variable in the polygon experiment was found to make a significant difference. (SD)

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STANFORD
MATHEMATICS
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STUDY GROUP

Working Paper No. 16

April, 1976

The Effects of Varying the Number of Practice Problems, Number of Examples, and Location of the Practice Problems in Elementary School Geometry.

By: E. G. Begle, T. Perl, B. Pence, and K. Ng

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INTRODUCTION

This study was conducted by the Stanford Mathematics Education Study Group in the spring of 1975 with the cooperation of the Cupertino Union School District and four elementary schools in that district.* It was designed as a further investigation of results yielded by a seventh grade study conducted the previous year in the same district (Pence, 1974). In the earlier experiment, using probability concepts, two variables (number of practice problems, and number of examples of concepts) had been manipulated. The conclusions from that experiment recommended further investigation of these variables, using other mathematical topics, and at other grade levels.

The study presented here was actually two experiments. The first of these, (the geometry experiment) using geometry concepts as the material to be learned, examined the variable of location of practice problems. Two versions of the programmed geometry text were written, each containing the same explanation and number of practice problems. The location of these problems, however, varied. In one text, all practice problems came immediately after the presentation of the concepts (massed practice). In the other, the practice problems were distributed throughout the text (distributed practice). The experimental question was the examination of the relative effectiveness of massed vs. distributed practice.

The second experiment in this study (the polygon experiment) using polygons as the topic, manipulated two variables, number of illustrative examples presented after each concept, and number of practice problems associated with each concept.

*The researchers acknowledge with thanks the cooperation and assistance of the following people: Ellie Amundsen, Math Coordinator, and the teachers of the participating classes, Ms. Gardner, Ms. Gibbs, Mr. Hargis, Mr. McCallam, Mr. Munger, Ms. Pangrac, Ms. Vogel.

POPULATION

Seven classes of fifth graders participated in this study. The classes were members of five schools, Hansen and Monta Vista (one class each), Portal (two classes), and Stevens Creek (three classes). The student body was thought to be of fairly uniform SES ... mainly white middle and upper middle class. In actual fact, more variation than had been anticipated was observed by the SMESG team.

As is standard procedure in the Cupertino Union School District, the participating classes had been streamed for math by ability groups. The classes in this study however included different ability levels. This variability should not be relevant to this study since the measured variables, pre and posttest scores and differences, are within subject dependent measures.

PROCEDURE

The procedure required five class periods to complete.

The first day (May 27) a pretest was administered to all seven classes under the supervision of the SMESG team. This pretest was a three part instrument:

Part I: Arithmetic Reasoning: 10 item multiple choice
5 minutes allowed for completion.

Part II: Geometry: 10 item (part yes, no; part multiple choice)
8 minutes allowed for completion.

Part III: Missing Words: 4 paragraph abbreviated version of test used in previous experiments.

All tests were adequately timed for most students to complete. Following the pretests, all subjects were asked to complete a short sample program in order to introduce them to the type of programmed materials which were to be used in the experiment.

The remaining procedures were administered under the supervision of the classroom teachers.

The second day (May 28 or 29) each student was randomly assigned one of two treatments of the programmed geometry text.

In Treatment J, all practice problems related to the concept were presented immediately after the concept.

In Treatment K, one practice problem was presented immediately after the concept. The remaining practice problems were interspersed throughout the text.

The third day, (May 30) students were administered a twenty-seven item geometry posttest.

The fourth day, (June 2) each student was randomly assigned one of four versions (Q, R, S, T) of the programmed text called Polygons.

Each version of the polygon's text contained the same total number of examples and the same total number of practice problems. Variations between texts occurred by subsets of concepts. In general, there were 12 polygon concepts. For 6 of the concepts there were 6 illustrative examples. For 6 of the concepts there was only one example. Three of the first 6 concepts were followed by - practice problems and three of the concepts were followed by one practice problem. The same procedure was repeated for the second six concepts.

To help visualize the text construction, first consider Figure I which shows the four combinations (A, B, C, D) generated by 2, two valued variables.

		Examples	
		Many	Few
Practice Problems	Many	A	C
	Few	B	D

Figure I

Figure II shows the distribution of these combinations over the 12 concepts in each of the four versions of the polygon texts.

Concepts / Combination of Variables	1-3	4-6	7-9	10-12
A	Q	R	S	T
B	R	Q	T	S
C	S	T	Q	R
D	T	S	R	Q

Figure II

Thus, all versions contained all four treatment combinations; they differ in that these combinations were applied to different sets of the 12 concepts in each version.

The last day (June 3) the polygons posttest was administered to all subjects. This was a 12 item test. Each item corresponded to one concept.

All programs and posttests were written specifically for this experiment. Concepts were presented in programmed form to control for teacher variability.

SCORING

A. Geometry

Scoring of the geometry posttest was conventional. The number of correct answers was the criterion used to measure the effect of the placement of the practice problems on achievement.

B. Polygons

Scoring of the polygons posttest concentrated on the number of errors.** There are, however, two kinds of errors which can occur in

**Original scoring instructions are given in Appendix 2.

concept formation, overgeneralization and undergeneralization. Overgeneralization is an error which occurs when students have not found all of the dimensions. An example of an overgeneralization would be, when told to mark triangular figures, the student may also mark a square demonstrating that the relevant dimension (the number of sides of a triangle) was overlooked or overgeneralized. Undergeneralization occurs when students derive extra dimensions. An example of undergeneralization would be failure to identify a triangle shown with the vertex located below the base because the student has concluded that an irrelevant dimension (relative location of the vertex) is relevant.

Scoring of the polygons posttest included measures for both types of errors. Overgeneralization scores (O - scores) were based upon the number of nonexamples of a concept which were marked. Undergeneralization scores (U - scores) were a function of the number of examples of the concept which were not identified.

ANALYSES AND RESULTS

A. Item Analyses

Before the data analysis was performed, all cases with missing test scores were omitted. An item analysis was performed on the Geometry Pretest, Arithmetic Reasoning Pretest, and the Geometry Posttest. Tables 1-2 of Appendix 1 give the results.

The reliability of the Arithmetic Reasoning Test was .638 which is similar to results obtained from other studies with Anglo children.*** Both the Geometry Pretest and Posttest had satisfactory reliabilities (.579 and .813 respectively).

***It is, however, quite different from the lower reliabilities such as .236 which have resulted in studies with Mexican-American students. This difference was the motivation for a study of the effects of teaching Mexican-American students how to use test taking strategies. The training intervention raised the reliability scores of the Mexican-American students to those expected from Anglo students. Findings are reported in SMESG Working Paper No. 14.

B. Geometry

The variable of placement of the practice problems was examined through the analyses -- regression and analysis of covariance. Results are shown in Tables 3-4 of Appendix 1. ANCOVA analyses showed no significant treatment differences. Whether the practice was given immediately after the development of the concept or distributed throughout the text makes no difference. This lack of any difference is in disagreement with the results of studies by Peterson, Laing, Camp, and Urwiller in which the trend, although not significant, favored the distributed placement of practice problems. The math topics for these studies were eighth grade arithmetic or first year high school algebra.

The results of the ANCOVA must be cautiously examined, however, since the homogeneity of regression assumption was rejected at the .002 level. Looking at the regression analysis, one predictor, missing words, accounts for varying amounts of variance in the posttest achievement. A significant amount of variance was predicted in the distributed practice treatment ($p < .000$) while in the massed practice treatment, the missing words pretest was not a significant predictor ($p < .707$).

The Missing Words Test was designed to measure the ability to read mathematical prose. An account of the development of this test is found in SMSG Working Paper No. 11, by Roger Jarvis. The Missing Words Test has been found to be reliable and to correlate significantly with mathematics achievement. The differential predictive effect of the missing words pretest supports the hypothesis that the effect of distributing the practice is increased as the student's ability to read mathematics increases.

C. Polygon Posttest

Means and standard deviations were computed for the pretest data for each treatment. (See Table 5 of Appendix 1). Comparisons of pretest results showed no significant differences between treatment groups.

In Table 6 of Appendix 1 the results of the simple data description are given for the polygon posttest. Both variables included in the

polygon text, number of examples and number of practice problems, were analyzed independently. Separate analyses were computed for the U-score and the O-score. Neither U-score or O-score comparisons across either treatment variable produced any significant difference.

Examples: In an earlier study with seventh graders and a unit on probability, the number of examples provided with each concept was not a significant variable. Details of the findings are included in SMESG Working Paper No. 7. Posttests for both Geometry and Polygons are included in Appendix 3.

See Table 6.

The results of both this present study and the previous study support the hypothesis that when an explicit definition is provided, the number of illustrative examples variable is swamped. A similar conclusion was reached in a recent report by Feldman (1974).

Practice Problems: Increasing the number of practice exercises did not help reduce the number of mistakes made in the learning of geometry concepts caused by either overlooking relevant dimensions or concentrating on irrelevant dimensions. This result contradicts the findings of the earlier study which showed interesting results. Increasing the number of practice exercises helped the less able student deal with relevant dimensions of the concept but was not a significant variable for the above average students. On the other hand, increasing the number of practice exercises did not help the less able students deal with irrelevant dimensions of concepts although it was helpful for the above average students. Increasing the number of practice problems was found to be helpful in another previous study (SMESG Working Paper No. 13) in which high school students studied a unit on Negative Number Bases. The effectiveness across the cognitive levels of Computation, Comprehension, and Transfer varied according to mathematics sophistication. While increased practice helped advanced math students on comprehension, the less sophisticed geometry students were helped by increased practice at all three levels of achievement.

CONCLUSIONS:

A. Geometry

Practice problems can be massed immediately after the concept, or distributed throughout the text following the concept. The effect of the location of the practice problems may be a function of the student's mathematics reading ability. The effect of distributed practice problems increased as math reading ability increased. On the average, however, there was no difference between massing and distributing practice problems in geometry.

B. Polygons

Based upon the results of previous SMESG studies, it was anticipated that increasing the number of examples would have no effect on achievement. This result was replicated in the Polygons experiment.

The effect of practice problems, however, did not replicate previcus results. Increasing the numbers of practice problems did not increase achievement for the polygon material. One reason for this unanticipated result may be the lack of power of the pretests. Learning geometric concepts may require specific abilities and thus demand a different set of pretests. For example, a test of Hidden Figures or test on spatial ability may be needed. Another source of variance which was not considered in the analyses is school differences. Even though all schools were analyzed together, observers related unexpected differences between schools both in student population and learning atmosphere.

BIBLIOGRAPHY

Begle, E. G., Pence, B., Tsang, S., and Enenstein, R. The Effects of Varying the Number of Practice Problems. SMESG Working Paper No. 13, 1975.

Camp, J. Massed vs. Distributed Homework Assignment. Unpublished doctoral dissertation, Columbia University, 1973.

Feldman, Katherine V. The Effects of Number of Positive and Negative Instances, Concept Definition, and Emphasis of Relevant Attributes in the Attainment of Mathematical Concepts. Wisconsin Research and Development Center, Technical Report No. 243, 1974.

Ginther, J. R., and Begle, E. G. The Effects of Pretraining Chicano Students on Parallel Test Items Before Administration of a Mathematics Predictor Test. SMESG Working Paper No. 14, 1975.

Jarvis, R. K. Predicting Mathematics Achievement on the Basis of Ability in Reading Mathematical Material. Missing Words Test. Pilot Studies, SMSG Working Paper No. 11, 1972.

Lang, R. Relative Effects of Massed and Distributed Scheduling of Topics on Homework Assignments of Eighth Grade Mathematics Students. Unpublished doctoral dissertation, Ohio State University, Columbus, Ohio, 1970.

Pence, B., and Begle, E. G. Effects of Varying the Number of Examples and Practice Problems. SMESG Working Paper No. 7, 1974.

Peterson, J. C. Effect of Exploratory Homework Exercises Upon Achievement in Eighth Grade Mathematics. Unpublished doctoral dissertation, The Ohio State University, 1969.

Urwiller, S. L. A Comparative Study of Achievement, Retention, and Attitude Towards Mathematics Between Students using Spiral Homework Assignments and Students using Traditional Homework Assignments in Second Year Algebra. Unpublished doctoral dissertation, University of Nebraska, Lincoln, 1971.

APPENDIX 1

STATISTICAL TABLES

TABLE 1

GEOMETRY PRETEST

SCALE STATISTICS:

NUMBER OF CASES	=	190
NUMBER OF ITEMS	=	10
MEAN TOTAL SCORE	=	5.516
STANDARD DEVIATION	=	1.879
CRONBACH'S ALPHA	=	0.579
ERROR OF MEASUREMENT	=	1.219

ITEM STATISTICS:

ITEM	P'S	ADJ. P'S	R.S. BIS	PERCENT NT
11	0.374	0.399	0.122	6.316
12	0.863	0.872	0.329	1.053
13	0.884	0.918	0.787	3.684
14	0.837	0.859	0.555	2.632
15	0.674	0.699	0.200	3.684
16	0.521	0.562	0.752	4.211
17	0.474	0.514	0.554	7.895
18	0.132	0.145	0.197	8.947
19	0.495	0.563	0.454	12.105
20	0.263	0.282	0.156	6.842

ARITHMETIC REASONING

SCALE STATISTICS:

NUMBER OF CASES	=	190
NUMBER OF ITEMS	=	10
MEAN TOTAL SCORE	=	4.532
STANDARD DEVIATION	=	2.184
CRONBACH'S ALPHA	=	0.638
ERROR OF MEASUREMENT	=	1.312

ITEM STATISTICS:

ITEM	P'S	ADJ. P'S	R.S. BIS	PERCENT NT
1	0.753	0.757	0.351	0.526
2	0.847	0.880	0.421	3.684
3	0.647	0.683	0.495	5.263
4	0.489	0.529	0.519	6.842
5	0.621	0.652	0.355	4.737
6	0.516	0.601	0.482	14.211
7	0.311	0.362	0.390	14.211
8	0.358	0.500	0.557	28.421
9	0.253	0.407	0.352	37.895
10	0.137	0.280	0.267	51.053

TABLE 2

GEOMETRY POSTTEST

SCALE STATISTICS:

NUMBER OF CASES	=	190
NUMBER OF ITEMS	=	36
MEAN TOTAL SCORE	=	25.247
STANDARD DEVIATION	=	5.208
CRONBACH'S ALPHA	=	0.813
ERROR OF MEASUREMENT	=	2.254

ITEM STATISTICS:

ITEM	P'S	ADJ. P'S	N.S. BIS	PERCENT NT
1	0.989	0.989	-0.452	0.0
2	0.926	0.951	0.593	2.632
3	0.747	0.747	0.278	0.0
4	0.863	0.963	0.093	0.0
5	0.963	0.963	0.455	0.0
6	0.547	0.547	0.512	0.0
7	0.863	0.836	0.214	2.632
8	0.968	0.968	0.454	0.0
9	0.947	0.947	0.736	0.0
10	0.905	0.905	0.079	0.0
11	0.989	0.989	0.710	0.0
12	0.921	0.921	0.431	0.0
13	0.505	0.508	0.337	0.526
14	0.921	0.926	0.137	0.526
15	0.653	0.656	0.168	0.526
16	0.921	0.926	0.459	0.526
17	0.395	0.395	0.360	0.0
18	0.768	0.768	0.430	0.0
19	0.468	0.468	0.030	0.0
20	0.811	0.811	0.482	0.0
21	0.768	0.772	0.493	0.526
22	0.626	0.633	0.358	1.053
23	0.763	0.771	0.698	1.053
24	0.842	0.851	0.420	1.053
25	0.226	0.226	0.640	0.0
26	0.232	0.232	0.665	0.0
27	0.916	0.926	0.460	1.053
28	0.668	0.672	0.446	0.526
29	0.500	0.505	0.770	1.053
30	0.426	0.431	0.575	1.053
31	0.679	0.679	0.505	0.0
32	0.511	0.511	0.526	0.0
33	0.268	0.270	0.352	0.526
34	0.562	0.566	0.341	0.526
35	0.747	0.747	0.671	0.0
36	0.437	0.439	0.592	0.526

TABLE 3

ANCOVA For GEOMETRY EXPERIMENT

DEPENDENT VARIABLE -- POST GEOMETRY
GROUP DEFINITION -- TREATMENT ID -- Massed vs Distributed Problems

ANALYSIS OF COVARIANCE

SOURCE OF VARIATION	ADJ. SS	DF	ADJ. MS	F	P
REGRESSION	2159.189	3.	719.729	41.286	0.000
TREATMENT MEANS	12.145	1.	12.145	0.697	0.405
HETEROGENEITY OF REGRESSION	265.135	3.	88.378	5.070	0.002
ERROR	3225.094	185.	17.433		
TOTAL	5661.562	192.			

ADJUSTED MEANS
VARIABLES BY GROUPS

VARIABLE NAME	NO.	GROUP 1	GROUP 2	TOTAL
POST GEOMETRY	5	25.52	25.01	25.26

TABLE 4

GEOMETRY EXPERIMENT - REGRESSION RESULTS

Treatment J -- Massed Practice Problems

SUMMARY TABLE DEPENDENT VARIABLE 4 POST GEOMETRY

VARIABLE NAME	VAR NO. REMOVED	VAR NO. ENTERED	STEP NO.	MULTIPLE R	RSQ	INCREASE IN RSQ	F VALUE TO ENTER/REMOVE	P	NO. OF INDEP VAR INCLUDED
PRE GEOMETRY		3	1	0.4680	0.2190	0.2190	26.3574	0.0000	1
PRE ARITH. REASONI		2	2	0.5271	0.2779	0.0589	7.5826	0.0071	2
PRE MISSING WORD		1	3	0.5282	0.2790	0.0011	0.1423	0.7069	3

****CORRELATION MATRIX****

		4	1	2	3
POST GEOMETRY	4	1.00	0.32	0.45	0.47
PRE MISSING WORD	1		1.00	0.45	0.49
PRE ARITH. REASONI	2			1.00	0.53
PRE GEOMETRY	3				1.00

Treatment K -- Distributed Practice Problems

SUMMARY TABLE DEPENDENT VARIABLE 4 POST GEOMETRY

VARIABLE NAME	VAR NO. REMOVED	VAR NO. ENTERED	STEP NO.	MULTIPLE R	RSQ	INCREASE IN RSQ	F VALUE TO ENTER/REMOVE	P	NO. OF INDEP VAR INCLUDED
PRE GEOMETRY		3	1	0.6133	0.3761	0.3761	57.2729	0.0000	1
PRE MISSING WORD		1	2	0.7183	0.5160	0.1399	27.1596	0.0000	2
PRE ARITH. REASONI		2	3	0.7400	0.5477	0.0317	6.5132	0.0123	3

****CORRELATION MATRIX****

		4	1	2	3
POST GEOMETRY	4	1.00	0.61	0.54	0.61
PRE MISSING WORD	1		1.00	0.49	0.45
PRE ARITH. REASONI	2			1.00	0.43
PRE GEOMETRY	3				1.00

TABLE 5

SIMPLE DATA DESCRIPTION OF POLYGON SCALE SCORES

GROUP NUMBER 1 GROUP SIZE = 193

VARIABLE NAME		MEAN	S.D.	STD ERROR	SAMPLE	MAXIMUM	MINIMUM	RANGE	PCNT MISS
E1	1	6.865	4.280	0.308	193	20.000	0.0	20.000	0.0
E2	2	6.984	3.583	0.258	193	18.000	0.0	18.000	0.0
E3	3	6.321	3.782	0.272	193	18.000	0.0	18.000	0.0
E4	4	6.358	3.771	0.271	193	17.000	0.0	17.000	0.0
P1	5	6.715	3.758	0.270	193	16.000	0.0	16.000	0.0
P2	6	7.135	3.896	0.280	193	17.000	0.0	17.000	0.0
P3	7	6.321	3.540	0.255	193	19.000	0.0	19.000	0.0
P4	8	6.358	3.320	0.239	193	15.000	0.0	15.000	0.0

END OF FILE 193 RECORDS

TABLE 6

POLYGON EXPERIMENT - POSTTEST RESULTS

	Examples	
	U-score	O-score
Many	6.865 s.d.4.280	6.321 s.d.3.782
Few	6.984 s.d.3.583	6.358 s.d.3.771

	Practice	
	U-score	O-score
Many	6.715 s.d.3.758	6.321 s.d.3.540
Few	7.135 s.d.3.896	6.358 s.d.3.320

APPENDIX 2

SCORING INSTRUCTIONS

Directions for Analysis of the Polygons Test

On the master scoring sheet for this test some of the figures in each item were outlined in color (these were always the figures which were examples of the polygon stated in the stem of the item both for the IS form of the stem and for the IS NOT form).

For each student and for each item two numbers were to be recorded. The first was the number of colored figures which were not marked by the students. Call this the student's A-score on this item. The second number was to be the number of uncolored figures which were marked by the students. Call this the student's B-score.

We will now create, for each student and for each item a U-score and an O-score. This is done by flipping the A and B scores for half the items as shown in Table 1.

For each student we now construct 8 composite scores. The rules for constructing these scores depend on the particular form (Q, R, S, or T) of the Polygons program which the student used. The rules for forming scores E-I, E-II, P-I, P-II are shown in Table 2.

We construct score E-III using exactly the same rule as E-I, except that the U-scores are replaced by the O-scores. Similarily E-IV follows the same rule as E-II but replaces the U-scores by the O-scores.

P-III uses the same rule as P-I and P-IV uses the same rule as P-II, in each case replacing the U-scores by the O-scores.

We now use t-tests to determine whether the distribution of E-I and E-II are different and similarily for the pairs E-III and E-IV, P-I and P-II, and P-III and P-IV.

Table 1

Item Number	O-Score	U-Score
1	B	A
2	A	B
3	B	A
4	B	A
5	A	B
6	A	B
7	B	A
8	B	A
9	A	B
10	A	B
11	B	A
12	A	B

Table 2

Score Form		
E-I	Q	Sum of U-scores on items 1 - 6
	R	" " 1 - 6
	S	" " 7 - 12
	T	" " 7 - 12
E-II	Q	Sum of U-scores on items 7 - 12
	R	" " 7 - 12
	S	" " 1 - 6
	T	" " 1 - 6
P-I	Q	Sum of U-scores on items 1 - 3 and 7 - 9
	R	" " 4 - 6 and 10 - 12
	S	" " 1 - 3 and 7 - 9
	T	" " 4 - 6 and 10 -12
P-II	Q	Sum of U-scores on items 4 - 6 and 10 - 12
	R	" " 1 - 3 and 7 - 9
	S	" " 4 - 6 and 10 - 12
	T	" " 1 - 3 and 7 - 9

APPENDIX 3

POSTTESTS

GEOMETRY

Name: _____

Sex: _____

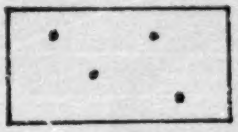
Date: _____

Time: Begin _____

End _____

Stanford Mathematics
Education Study Group

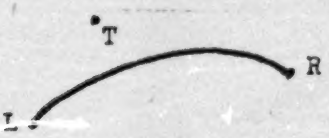
1. In the box below, how many points are represented by dots? _____



2. Mark four points in the space below.

   Name them with the first four letters of the alphabet.

3. The curve below connects points _____ and _____.

4. 

   Is LT a correct name for the curve above? _____

5. Is there a curve shown going from A to M? _____

   Is there a curve shown going from M to E? _____

6.

   How many points are marked on line segment NR? _____

7.

$\overline{AC}$ is a line segment.

Does a line segment have endpoints? _____

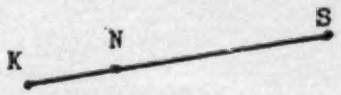
8. In the figure below, is M an endpoint of line segment MC? _____

Is R an endpoint of line segment MC? _____

Is C an endpoint of line segment MC? _____

9. Mark an X on each line segment below.

10. Line segment $\overline{KS}$ is shown below.



Write names for two other line segments. _____ _____

Is $\overline{KN}$ part of $\overline{KS}$? _____

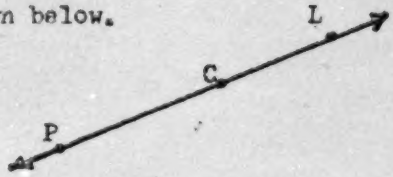
Is $\overline{KN}$ part of $\overline{NS}$? _____

11.

$\overleftrightarrow{BD}$ is a line.

Does a line have endpoints? _____

12. Line $\overleftrightarrow{CL}$ is shown below.

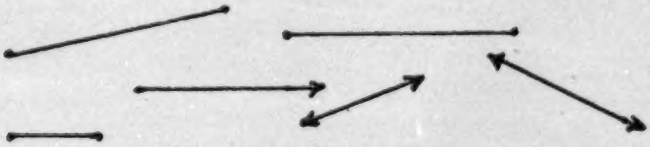


Write two more names for this line. _____ _____

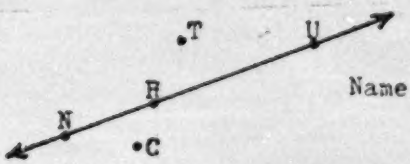
Is line segment $\overline{CL}$ part of line $\overleftrightarrow{CL}$? _____

Is $\overline{PC}$ part of $\overleftrightarrow{CL}$? _____

13. Mark an X on each line below.



14.



Name the points marked on the line above.

_____

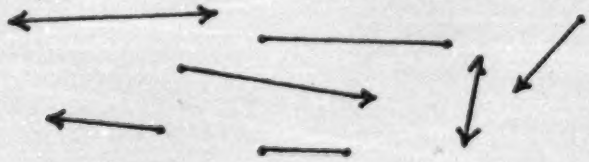
$\overleftrightarrow{NU}$ is a correct name for the line above.

Another correct name for $\overleftrightarrow{NU}$ is _____.

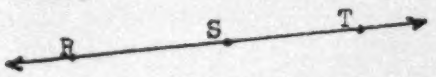
15. Here is a picture of ray YZ.

Name the endpoint of ray YZ. _____

16. Mark an X on each ray in the figure below.



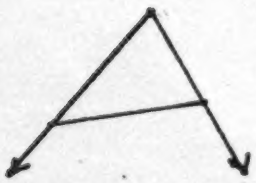
17. Here is a picture of a line.



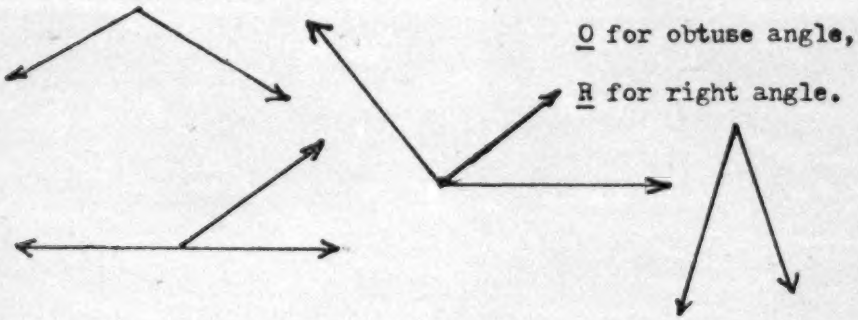
Name three rays on this line. _____ _____ _____

18. Name the rays that form this angle. _____ _____

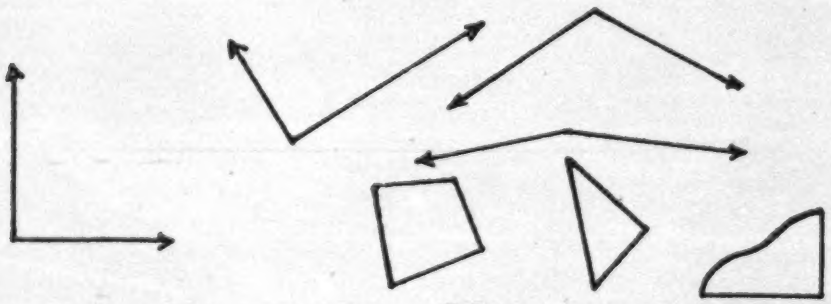
Name the point at which the rays meet. _____

19.  Mark all the angles in this figure.

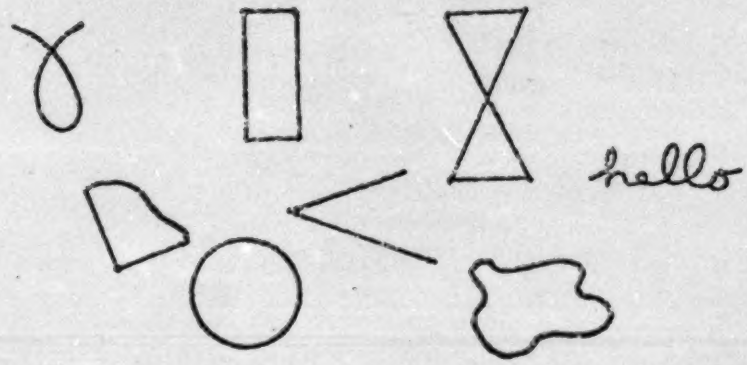
20. Mark the angles in the figures below, A for acute angle,
O for obtuse angle,
R for right angle.



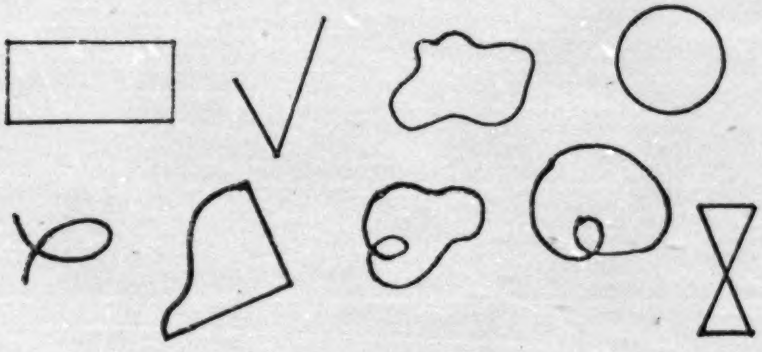
21. Mark all the right angles with an R.



22. Mark an X on the figures below which are closed curves.

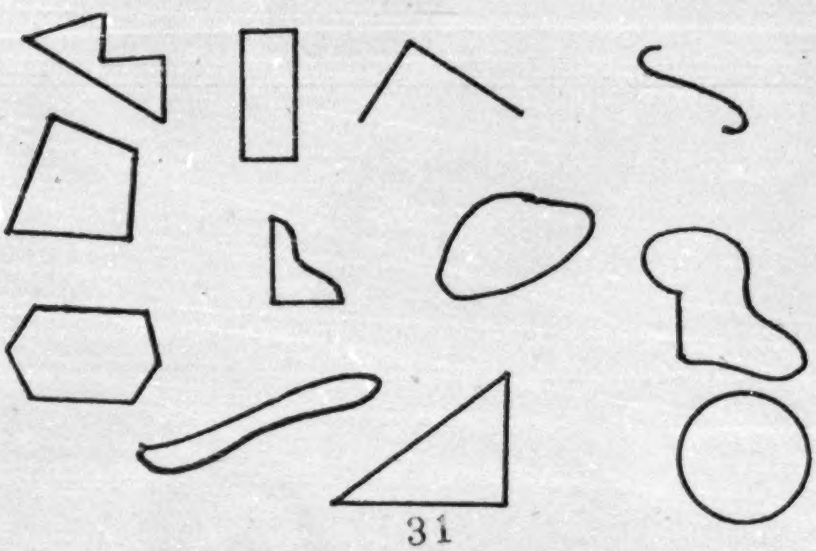


23. Mark an X on the figures below which are <u>simple</u> closed curves.

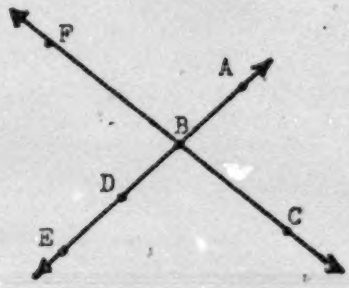


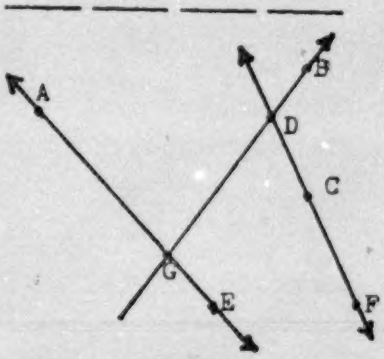
24. Which of these are pictures of polygons?

Mark each polygon with a P.

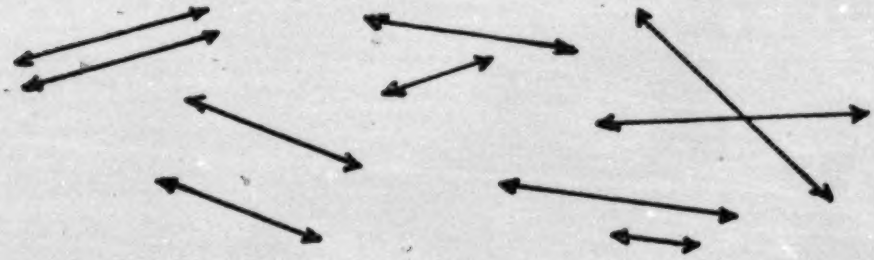


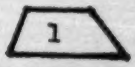
25. Name the intersection points on each figure below.

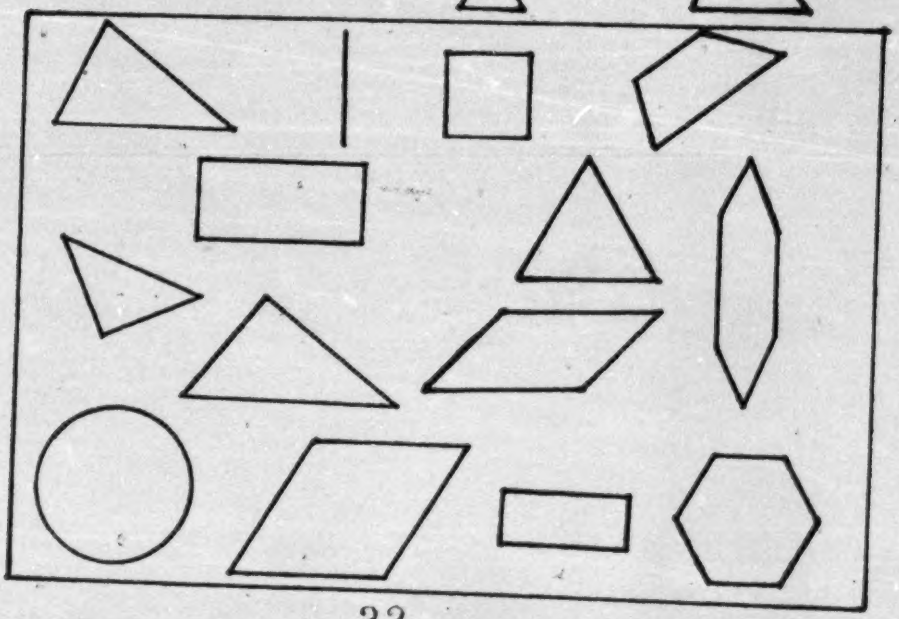




26. Mark an X on the sets of lines which are parallel.



27. Write the number of pairs of parallel sides you see in each figure below. For example: and 

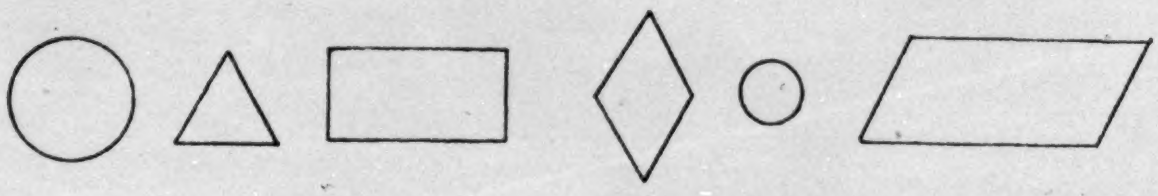


POLYGONS

Form A

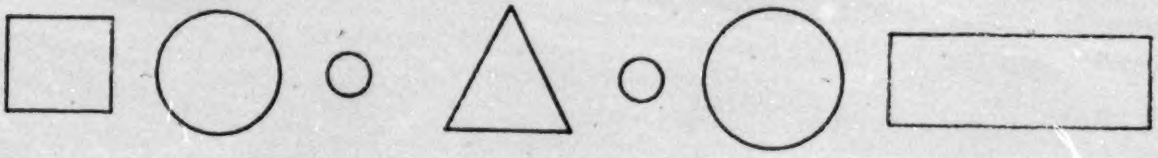
There are twelve questions in this booklet. Each one shows some geometric shapes. You are told to mark some of them. Here is an example:

0. Mark an × on each CIRCLE.



Here is another example:

Mark an × on each figure that is NOT a CIRCLE.



Name: _____

Sex: _____

Date: _____

Time: Begin _____

End _____

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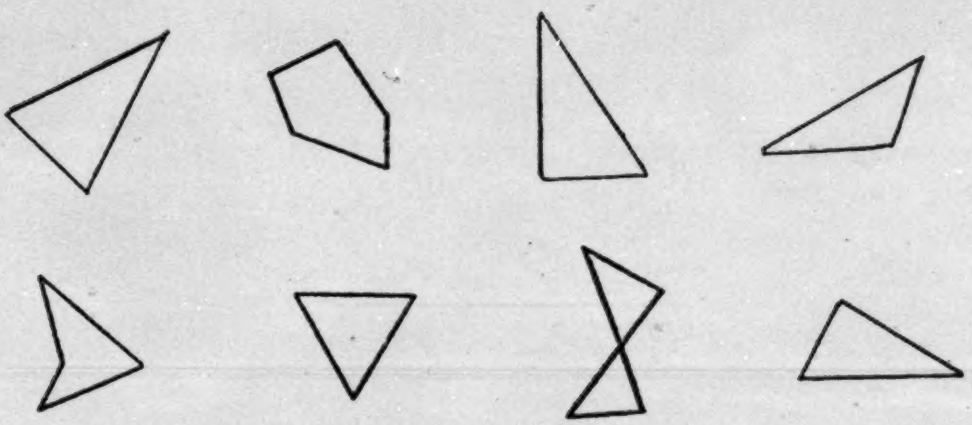
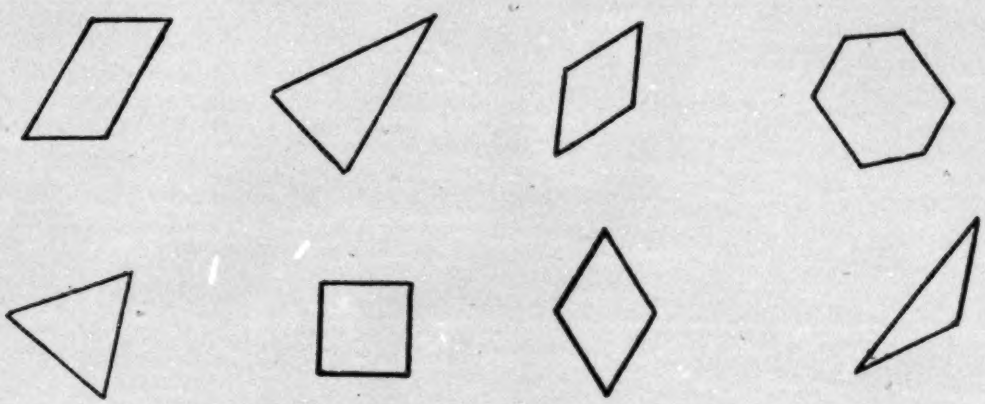
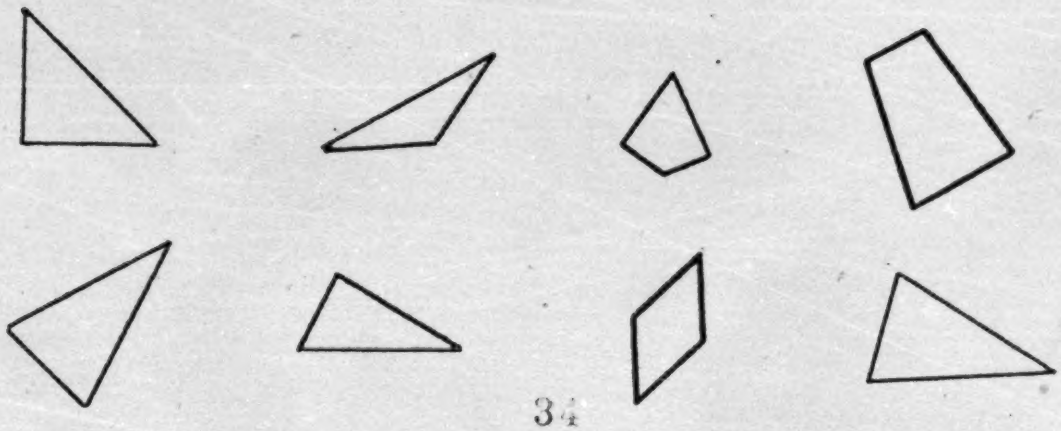
Mark an × on each TRIANGLE.



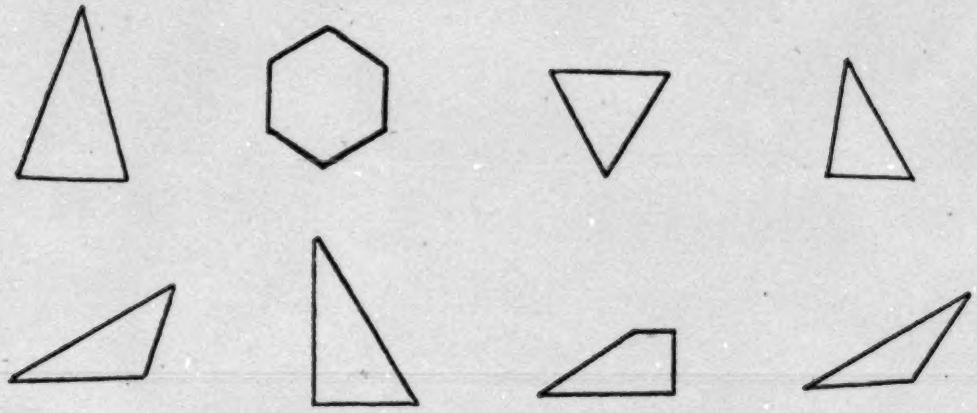
Mark an × on each figure that is NOT a EQUILATERAL TRIANGLE.



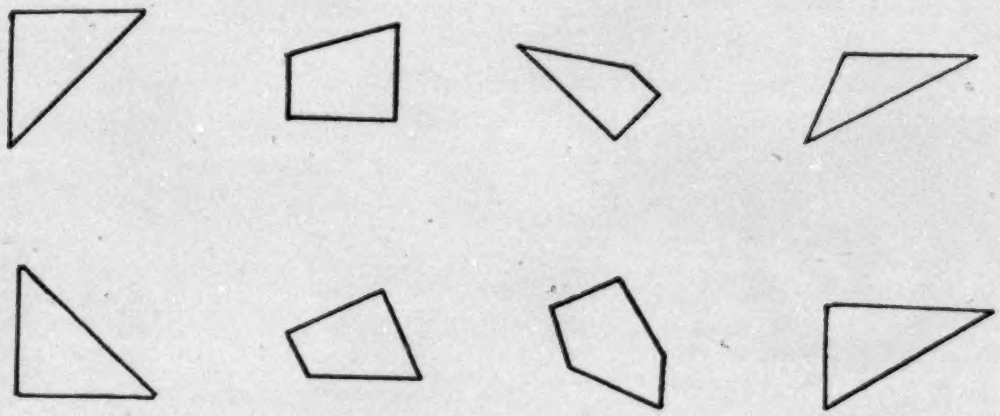
Mark an × on each ISOSCELES TRIANGLE.



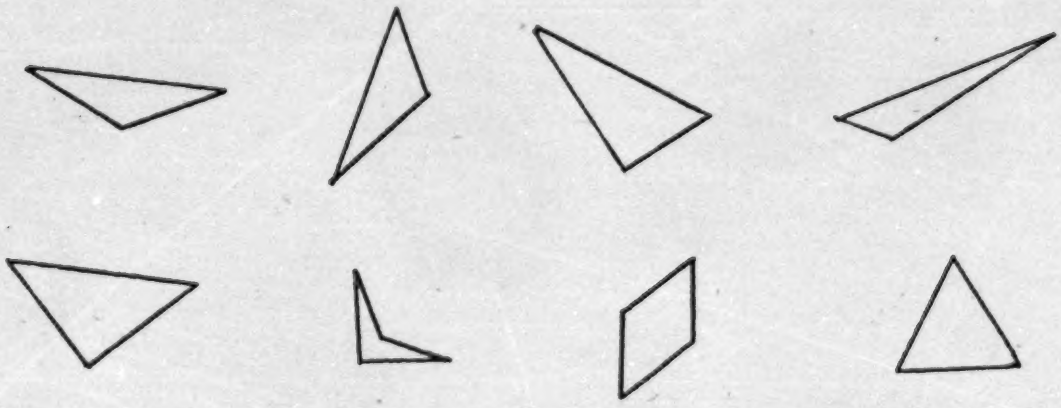
Mark an × on each ACUTE ANGLE TRIANGLE.



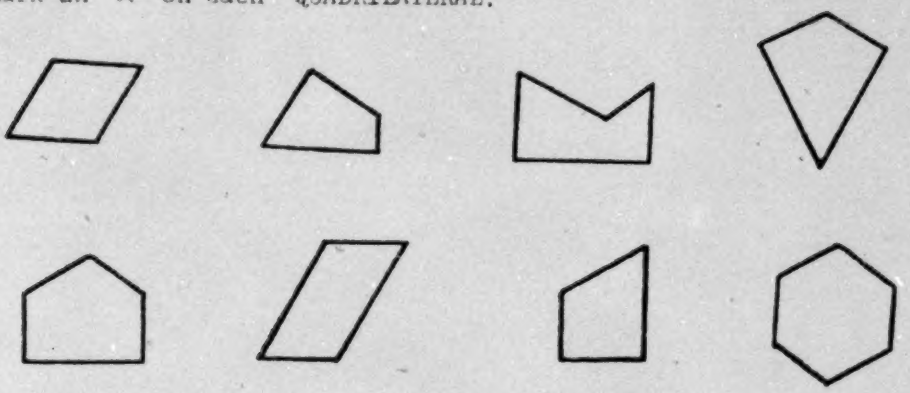
Mark an × on each figure that is NOT a RIGHT ANGLE TRIANGLE.



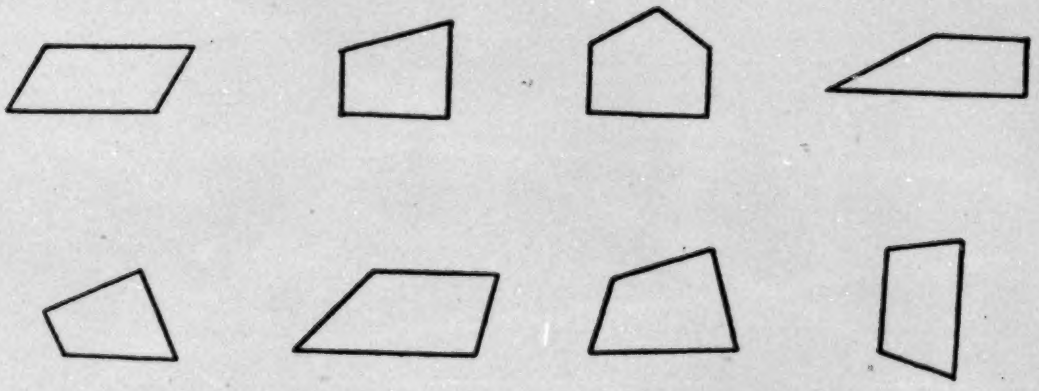
Mark an × on each figure that is NOT a OBTUSE ANGLE TRIANGLE.



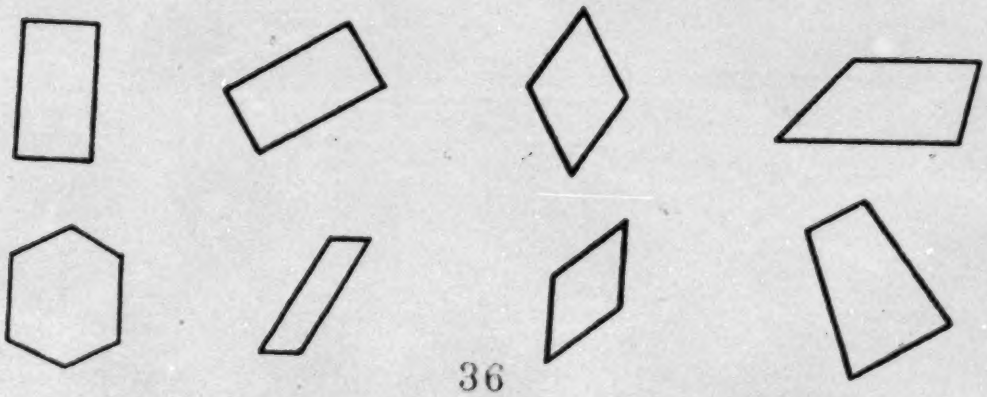
Mark an × on each QUADRILATERAL.



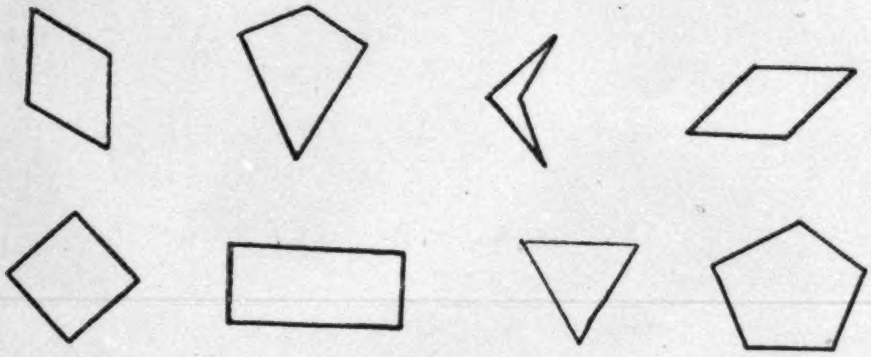
Mark an × on each TRAPEZOID.



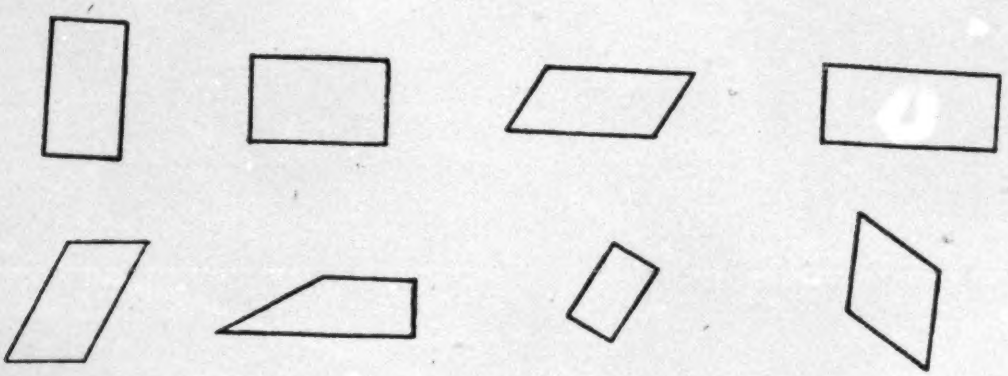
Mark an × on each figure that is NOT a PARALLELOGRAM.



Mark an × on each figure that is NOT a RHOMBUS.



Mark an × on each RECTANGLE.



Mark an × on figure that is NOT a KITE.